



The Diploma in Distilling

Examination Syllabus

1	MODULE 1	1
1.1	Raw Materials	1
1.1.1	Cereals/Molasses	1
1.1.2	Water	1
1.2	Materials Processing in the Distillery	1
1.2.1	Cereal intake, handling, storage and processing	1
1.2.2	Non-cereals intake, handling, storage and processing	1
1.3	Cereal Wort Production	1
1.3.1	Principles and purpose of mashing	1
1.3.2	Principles and purpose of wort separation	1
1.3.3	Wort cooling and oxygenation	1
1.4	Non-cereal Wort Production	1
1.4.1	Molasses wort production	1

1.5	Yeast and Bacteria	1
1.5.1	Properties of yeast and bacteria	1
1.5.2	Yeast Metabolism	2
1.6	Fermentation	2
1.6.1	Yeast handling	2
1.6.2	Principle fermentation variables	2
1.6.3	Fermentation technology	2
2	MODULE 2	3
2.1	Distillation	3
2.1.1	Distillation theory	3
2.2	Batch Distillation	3
2.2.1	Design	3
2.2.2	Operation	3
2.2.3	Ethanol profiles	3
2.2.4	Congener behaviour	3
2.2.5	Pre-distillation influences on quality	3
2.2.6	Effect of copper	3
2.3	Continuous Distillation	3
2.3.1	Design	3
2.3.2	Operation	4
2.3.3	Ethanol profiles	4
2.3.4	Congener distribution	4
2.3.5	Pre-distillation effects on quality	4
2.4	Post Distillation Modification of Flavour	4
2.4.1	Basic concepts of maturation	4
2.4.2	Principal factors involved in maturation	4
2.4.3	Properties of oak wood	4
2.4.4	Cask types and properties	4
2.4.5	General nature of maturation changes	4
2.4.6	Cask filling	5
2.4.7	Non-matured spirits: gin and vodka:	5
2.5	Quality	5
	Quality management	5
	Laboratory analysis	5
2.5.3	Sensory analysis	5
2.5.4	Hygiene	5
3	MODULE 3	6
3.1	Resource Management	6
3.1.1	Environment	6
3.1.2	Health and Safety	6
3.1.3	Utilities	6
3.1.4	Maintenance	6

3.2 Fluid Mechanics	6
3.2.1 Principles of fluid mechanics	6
3.2.2 Process Gases	7
3.3 Heat Transfer	7
3.3.1 Principles of heat transfer	7
3.3.2 Steam	7
3.3.3 Refrigeration	7
3.4 Process Control and Instrumentation	8
3.4.1 Process control	8
3.4.2 Instrumentation	8
3.5 Materials of Construction	8
Classification and properties	9
3.5.1	9
3.5.2 Applications and limitations	9
3.6 Packaging	9
3.6.1 Blending	9
3.6.2 Bottling	9

1 MODULE 1

1.1 Raw Materials

1.1.1 Cereals/Molasses

- Barley
- Malting process
- Molasses
- Other cereals

1.1.2 Water

- Basic quality requirements of water
- Production requirements of water in distilleries
- Water sourcing

1.2 Materials Processing in the Distillery

1.2.1 Cereal intake, handling, storage and processing

- Malt performance- requirements of good quality malt
- Key malt analytical parameters and their measurement
- Malt delivery and handling
- Milling

1.2.2 Non-cereals intake, handling, storage and processing

- Molasses intake and processing

1.3 Cereal Wort Production

1.3.1 Principles and purpose of mashing

- Mashing procedures for all-malt mash
- Cereal cooking
- Enzymes for GNS and whiskey production
- Wort Properties

1.3.2 Principles and purpose of wort separation

- Wort separation theory and methods
- Production and handling of co-products

1.3.3 Wort cooling and oxygenation

- Wort cooling
- Wort oxygenation

1.4 Non-cereal Wort Production

1.4.1 Molasses wort production

- Composition of molasses
- Principles of mashing/pre-treatment
- Concerns for molasses wort production

1.5 Yeast and Bacteria

1.5.1 Properties of yeast and bacteria

- Properties of yeast
- Yeast reproduction
- Yeast classification
- Microbial spoilage organisms in molasses

1.5.2 Yeast Metabolism

- Carbohydrate metabolism by yeast
- Metabolic pathways
- Production of flavour compounds

1.6 Fermentation

1.6.1 Yeast handling

- Yeast handling in the distillery

1.6.2 Principle fermentation variables

- Progress of fermentation
- Alcohol sensitivity of yeast

1.6.3 Fermentation technology

- Fermentation vessel types and design

2 MODULE 2

2.1 Distillation

2.1.1 Distillation theory

- Vapour/liquid equilibrium in ethanol/water distillation
- Relationship between relative volatility and ethanol concentration - Theoretical plates
- Deviations from theoretical behaviour:
- Azeotropes

2.2 Batch Distillation

2.2.1 Design - Still size

- Still design and construction

2.2.2 Operation

- Still operation
- Cutting points
- Double and triple distillation
- Measurement of ethanol concentration
- Duration of still operation

2.2.3 Ethanol profiles

- Ethanol profile of wash still distillation
- Ethanol profile of spirit still distillation
- Importance of optimising ethanol recovery

2.2.4 Congener behaviour

- Types of congener
- Effect of changes in spirit still cut points
- Removal of congeners from the system

2.2.5 Pre-distillation influences on quality

- Water supply
- Raw materials
- Culture yeast(s) and fermentation
- Microbial infection

2.2.6 Effect of copper

- Thermal degradations and the role of copper
- Aspect ratios in still design and the effect on spirit quality
- Removal of sulphur compounds by reaction with copper

2.3 Continuous Distillation

2.3.1 Design

- Basic single-column continuous still
- Two-column still systems
- Multi-column still systems
- Plate/column design
- Heating of column stills

2.3.2 Operation

- Still operation
- Start-up and close-down procedures
- Re-distillation of spirit below specification

2.3.3 Ethanol profiles

- Wash strength
- Ethanol profile in the rectifier column
- Control of reflux ratio
- Control of distillate concentration
- Legal ethanol concentrations for grain whisky spirit and neutral spirit (UK/EU)

2.3.4 Congener distribution

- Types of congener
- High volatile congeners in spirit and heads streams
- Low volatile congeners in spent wash
- Recycling of hot and cold feints
- Recovery of fusel oil from rectifier column and recycling of ethanol

2.3.5 Pre-distillation effects on quality

- Water supply
- Raw materials
- Culture yeast(s) and fermentation
- Microbial infection
- Influence of copper in column stills

2.4 Post Distillation Modification of Flavour

2.4.1 Basic concepts of maturation

- Characteristics of new and mature spirit - Immature characteristics to be removed
- Desirable mature attributes

2.4.2 Principal factors involved in maturation

- Cask type
- Spirit strength
- Storage conditions, especially temperature and humidity
- Effect of atmospheric oxygen

2.4.3 Properties of oak wood

- Physical properties: low porosity, internal structure, resistance to cracking
- Chemical composition of oak wood
- American and European oaks

2.4.4 Cask types and properties

- Manufacture of new casks
- Refill casks
- Matching of spirit to cask

2.4.5 General nature of maturation changes

- Physical and chemical effects during maturation

2.4.6 Cask filling

- Principles of cask filling

2.4.7 Non-matured spirits: gin and vodka:

- Quality standards of cereals for gin and vodka production
- Botanicals for distilled gin
- Operation of gin still
- Recovery of gin feints for re-use
- Preparation and use of essences for non-distilled gin
- Purification of spirit for vodka

2.5 Quality

2.5.1 Quality management

- Quality control principles and practices
- Quality assurance principles and practices
- International standards
- Food safety
- Procedures and controls
- The basic principles of analytical and on-line measurement techniques
- Hazard Analysis Critical Control Point (HACCP)

2.5.2 Laboratory analysis

- Basic analytical techniques and their use in distilling
- The basic concepts applied to interpretation of analytical data

2.5.3 Sensory analysis

- Basic sensory techniques and their use in distilling

2.5.4 Hygiene

- Microbial contamination:

- Preventing microbial contamination:
- Cleaning-in-Place (CIP) principles
- Design and operation of CIP systems
- Detergents and sanitising agents
- Detection and quantification of residual surface contamination

3 MODULE 3

3.1 Resource Management

3.1.1 Environment

- Sustainability and climate change
- Energy conservation
- principle energy consuming activities
- energy reduction strategies
- Water conservation
- purposes for water in distilling operation
- water conservation strategies
- Waste minimization

3.1.2 Health and Safety

- Fundamental considerations
- health and safety in the food and drink industry
- relevant national and local legislation and regulations
- principle of duty of care
- Understanding of workplace hazards and precautions
- techniques for assessing hazards and risks
- safe working practices
- accident investigation and reporting

3.1.3 Utilities

- Water use and treatment
- different types of water and their uses
- Effluent treatment
- Compressed air
- common systems for compressed air production
- components of air distribution systems
- quality requirements for distilling operations
- Managing utilities
- typical utilities usage for distilling

3.1.4 Maintenance

- Aims of maintenance
- Approaches to maintenance
- Maintenance tasks
- types and variety of maintenance tasks in distilling
- Organisation
- planning of maintenance activities
- Performance improvement
- principle performance initiatives

3.2 Fluid Mechanics

3.2.1 Principles of fluid mechanics

- Forms of fluid and fluid energy
- Properties of moving fluids
- Friction loss
- Pumps
 - centrifugal pumps
 - positive displacement pumps
- cavitation and net positive suction head (NPSH)
- Valves
 - design features and merits of different types of valves

3.2.2 Process Gases

- Carbon Dioxide liquification

3.3 Heat Transfer

3.3.1 Principles of heat transfer

- Forms of heat energy
- definition of specific heat
- latent heat and exothermic heat
- calculations of energy change
- Heat transfer mechanisms
 - conduction, convection and radiation
- calculation of the overall heat transfer coefficient
- effects of fouling and scaling
- Heat exchanger sizing
 - concept of the heat balance and heat transfer across a temperature gradient
 - co-current and counter-current flow in a heat exchanger
- Plate heat exchanger designs
 - construction, components and configuration of a heat exchanger
 - importance of fouling/scaling problems
- CIP techniques
- heat exchanger calculations
- heat exchanger applications in distilling
 - Jacketed vessels
 - Shell and tube heat exchangers
 - shell and tube heat exchanger designs and configurations
 - applications in distilling
- Insulation
 - function of insulation
 - choice of materials

3.3.2 Steam

- Steam properties

- reasons for using steam
- temperature-energy relationship as illustrated in the Mollier chart - steam tables
- specific heat of liquid water
- latent heat of vaporisation
- Steam raising and distribution
- boiler design
- pipe sizes, arrangements and design velocities
- insulation
- steam traps
- control valves, reducing valves and relief valves
- legal requirements in having a properly designed, safe system with the correct protection measures
- Principal steam applications

3.3.3 Refrigeration

- Refrigeration theory
- definition of refrigeration
- concept of pressure/temperature equilibrium in relation to the vapourcompression refrigeration process
- refrigeration cycle
- function of evaporator, compressor, condenser and expansion valve
- Refrigeration practice and the refrigeration cycle
- Principal plant items
- compressors
- condensers
- evaporator and expansion devices
- Primary refrigerants
- purpose, design and choice
- available refrigerant types and costs
- physical and chemical properties
- Secondary refrigerants
- purpose, design and choice
- chemical properties
- safety and environmental concerns
- Refrigeration applications
- Reasons for use

3.4 Process Control and Instrumentation

3.4.1 Process control

- Basic control elements
- Sensors, controllers and actuators
- Basic on/off control
- Timers, thermostats, pressure switches, proximity switches and others
- Sequence control

- description of programmable logic controller (PLC)
- examples of plc applications
- Aim of process control
- Principles of process control
- Control arrangements
- Typical control systems
- Actuation
- Control system arrangements
- self-actuating controllers
- individual electronic analogue controls
- small local computer control
- Supervisory Control and Data Acquisition (SCADA), Management Information Systems (MIS) and other large digital systems
- comparative costs

3.4.2 Instrumentation

- Factors determining the choice of sensors
- Typical conventional sensors
- including pressure, volume flow, temperature, mass flow level and vessel contents
- Typical analytical sensors
- including CO₂, O₂, optical devices, pH, density and alcohol content

3.5 Materials of Construction

3.5.1 Classification and properties

- Carbon and low alloy steels
- Stainless steels
- Other metals including copper (and alloys), aluminium and cast iron -
Plastics and glass

3.5.2 Applications and limitations -

Advantages and disadvantages

- Applications

3.6 Packaging

3.6.1 Blending

- Basic principles of spirits blending prior to packaging

3.6.2 Bottling

- Chill Filtration
- Packaging Materials – Primary, Secondary and Tertiary
- Packaging line design
- Packaging line operation